Tuesday, 2/22/00 –

Buildup of the Twin Otter payload continued today. Almost all of the instruments were installed and the Twin Otter payload was checked on ground power outside of the Greenwood Aviation Hangar at the Ponca City airport. A few additional items will be addressed on Wednesday morning, 2/23/00, in preparation for a possible engineering flight near mid-day. Severe storms moved through the area today with heavy rain and lightning. These conditions are expected to continue through this evening leading to the possibility of low clouds without convective activity on Wednesday - potentially suitable for the engineering flight.

Wednesday, 2/23/00 –

Wednesday was planned for an engineering flight of the Twin Otter payload and systems. The weather was favorable for an engineering flight but not for scientific data taking. The day started with an "all hands" meeting at the Greenwood hangar at Ponca City. After final instrument installation, the Twin Otter was flown to Blackwell-Tonkawa Airport at approximately 11:30 am. Following a preflight briefing, the preflight checklist was started at about 12:30 pm. During the preflight checklist, a power distribution problem surfaced and the engineering flight was scrubbed. The problem is being diagnosed this evening in preparation for a planned engineering flight on Thursday.

Thursday, 2/24/00 –

The engineering flight was launched at 1:01 pm CST today. Sky conditions were nearly clear at high altitude (with thin cirrus early, clearing later in the flight) with scattered cumulus and haze at 4,000 to 6,000 ft. The Twin Otter flew the "daisy" pattern over the CART site at 24,000 ft for approximately 50 minutes. Low altitude albedo runs were flown over the CART site, before and after the daisy pattern, at 500 ft AGL. The albedo runs consisted of two 5 minute legs - one aligned with the sun direction and one at 90 degrees to the sun direction over the CART radiometer tower. The flight started with an instrument check flown at the Ponca City Airport to confirm that the aircraft navigation instruments functioned properly with the payload installed and turned on (this phase of the flight should not need to be repeated). Total flight time was 3 hours 4 minutes.

Friday, 2/25/00 -

Severe storms moved through the area in the early morning hours of Friday followed by clearing skies and high winds (southerly at about 20 kts with 30 kt gusts). Friday and Saturday were devoted to aircraft maintenance and other minor payload items. Clear conditions are expected over the weekend; therefore, we are planning a clear sky flight on Sunday.

The next anticipated flight day is Sunday, 27 February 2000, planned as a clear-sky mission. The planned flight will follow exactly the same pattern outlined in the science plan for overcast conditions - 500 ft AGL overflight of the CART site, ascent to 20+ kft and repeated daisy patterns over the CART site, followed by a 500 ft AGL over flight of the CART site. Both the

Terra and the TRMM satellites will fly over the CART site during the time of the aircraft operations at the 20 kft level. Pat Minnis reports that both CERES TRMM and CERES Terra were expected to be operating by this afternoon.

Saturday, 2/26/00 -

Today was spent on aircraft and payload maintenance in preparation for a clear sky science flight on Sunday, 2/27/00. The flight planned for tomorrow will be the first science flight in the ARESE II campaign.

Issues addressed today include: replacement of brake system hydraulic accumulator on the Twin Otter, evaluation of one of the on-board data tape recorders, and checks and maintenance on several of the payload instruments.

Sunday, 2/27/00 -

Sunday started with a virtually clear sky with only a few small patches of high stratus clouds to the southwest. The clear sky measurement flight was launched at 10:05 am. The flight plan included two orthogonal low altitude passes over the CART central facility radiometer tower at 500 ft AGL, followed by climb to 23,000 ft for repeated passes over the CART site on the "daisy" pattern. The period of the high altitude flight over CART was timed to coincide with the over flight of two satellites: Terra at 11:20 am CST and TRMM at 11:53 am CST. The Twin Otter was on station at 23,000 ft taking data 22 minutes before the first satellite overflight and continued taking data for 1 hour 3 minutes after the second satellite overflight (this period also included local solar noon). Following the high altitude patterns and the second albedo passes over CART, the Twin Otter returned to Ponca City Airport. Some cirrus clouds built up to the southwest of the CART site but did not appear directly over CART. Local brush burning resulted in near-surface smoke around CART but smoke did not pass closer that about 7 miles southeast of the central facility. Landing was at about 2:10 pm. Time at altitude was 2 hours 2 minutes and total flight time was about 4 hours 5 minutes.

Monday, 2/28/00 and Tuesday, 2/29/00 -

Monday and Tuesday were data review and planning days. Wednesday, 3/1/00 and the following few days are expected to bring significant clouds into the area; therefore, Wednesday is planned as a cloudy sky science flight. Wednesday will also provide an opportunity for comparison with the Terra satellite. The plans for Wednesday will be finalized on Tuesday.

Wednesday, 3/1/00 -

Flight decision was finalized at 6:30 am CST. Clear skies were expected to evolve into high cirrus as the morning progressed. As this is the first day of the Cloud IOP, some ground-based instruments are not yet operational. Radar facilities are operational at the CART CF and at the Supplemental Facility #2 (SF2). A new flight plan, dubbed Cloud IOP Experiment #4, is being

flown today. The Twin Otter flies 50 km legs centered over each site. Flight direction is 60°/240° to align with the wind direction at cloud level. We fly to the SW over the CF, turn 180° and fly NE over the SF2, followed by another turn. The SPEC Lear Jet is flying the same pattern but in the opposite direction. The ER-2 is flying at 20 km in the same pattern. Twin Otter takeoff was at 10:34 am CST. Operational altitude began near 23,000 ft MSL but kept dropping as the cloud level descended. The flight was coordinated with a Terra over crossing at 11:51 am CST. Landing occurred at 1:34 pm CST.

After refueling and reloading the oxygen bottles, the Twin Otter returned for a second flight similar to the first. Improved cirrus conditions provided a good opportunity for data collection. Takeoff was at 3:30 pm CST. The flight ended early due to a payload anomaly. Landing at Ponca City occurred at 5:21 pm CST.

Thursday, 3/2/00 -

Harsh storms in the area precluded science flights for the day. PIs had the opportunity to review instrument data from yesterday. Payload maintenance and repair issues are being worked. Planning and preparations are being made for an ARESE flight on Friday. Significant cloudiness is expected, as well as a Terra satellite crossing. Weather uncertainty may delay the final go/no-go decision until Friday morning.

Friday, 3/3/00 -

Flight decision was finalized at 6:30 am CST. A heavy stratus layer dominated the region today, providing an excellent opportunity to collect ARESE II data. Problems developed in two of the instruments during the preflight checks. Both were resolved but caused a delay in the mission. After takeoff at 10:56 am CST, the Twin Otter climbed directly to altitude in order to be on station prior to the 11:39 am over crossing of the Terra satellite. Fifteen complete legs of the lopsided daisy pattern were flown at altitude, primarily at 23,000 ft. Each leg is 14 miles long and crosses the CF. Length of the leg from the CF varies from 5 to 9 miles, with longer legs extending into the "radar triangle" formed by the CF, SF2 and BT. At the end of the flight, two albedo crossings of the CF were made at 500 ft AGL. The flight ended at 2:43 pm CST. The ER-2 was flying a racetrack pattern at high altitude. The Citation did in situ profiling of the stratus layer. After climbing to the cloud tops, it spiraled downward over the CF, SF1 and SF2 sites. This was followed by a 50 km turbulence run upwind, returning along the cloud tops.

Saturday, 3/4/00 -

A scheduled clear sky mission was canceled due to pilot illness. This provided an opportunity for payload maintenance activities, data reduction and planning for a cirrus or clear sky flight tomorrow.

Sunday, 3/5/00 -

The final flight decision came at 6:30 am CST. We planned to fly a clear sky ARESE mission, with the possibility of some cirrus patterns if clouds moved in later in the flight. Takeoff was at 10:32 am CST, followed by a pair of albedo runs over the CART site. The aircraft climbed to 19 Kft altitude and was on-station 10 minutes before and after the 11:27 am over crossing of the Terra satellite. Scattered cirrus covered the area during most of the flight, with the exception of the time during the albedo runs at the beginning and end of the flight. Landing was at 2:10 pm. Fifteen data legs were run between 16 and 19 Kft.

Monday, 3/6/00 -

Today was a data reduction and crew rest day. PIs had the opportunity to review instrument data from yesterday. Payload maintenance and repair issues are being worked. Planning and preparations are being made for a possible ARESE flight on Wednesday.

Tuesday, 3/7/00 -

Today was a scheduled down day due to anticipated unfavorable weather conditions and personnel needs. Planning began for a possible ARESE flight for Wednesday. Final decision for go/no-go will again be made early in the morning. Some engineering tests will be flown if weather conditions are favorable and there is no science flight.

Wednesday, 3/8/00 -

Clears skies and strong winds precluded any science or engineering flights for today. Minor payload work is being done. More detailed plans are being made for doing an engineering ground and flight test tomorrow. Friday is the next possibility for a science flight.

Thursday, 3/9/00 -

A two-hour engineering flight was completed in the morning. This was followed by a series of ground-based tests. A cirrus layer developed in the early afternoon. After refueling, the Twin Otter returned to Blackwell and went through the preflight checklist. Takeoff occurred at 3:02 pm CST. After climbing directly to 17,000 feet, a total of 7 data legs were run along the wind direction. These were straight legs 50 km in length at a heading of 70°/250°, centered over the CART CF. Total time at altitude was over 2 hours. Landing occurred at 5:55 pm CST.

Friday, 3/10/00 -

After preparing to fly an ARESE mission, cloud conditions forced us to cancel. We subsequently reconfigured the payload to support flying the Cloud IOP Experiment #2. Takeoff occurred at 11:12 am CST. After climbing to 7000 feet, we flew 23 data legs over the radar triangle area near the CART site. The legs ran along 165/345 degrees, 10 miles in length and 2.5 miles apart. The five parallel legs were flown normal to the wind direction. Total time at altitude was nearly two and a half hours. Landing occurred at 2:10 pm.

Saturday, 3/11/00 -

Clear skies with some scattered clouds prevailed today after six inches of snow blanketed the area last night. No flight is scheduled for today or tomorrow. Payload maintenance activities are being performed in Ponca City. Data reduction and analysis activities continue at the Blackwell-Tonkawa facility.

Sunday, 3/12/00 -

The prevailing clear sky conditions did not favor either ARESE or IOP flights on Sunday. This was a crew rest day and an opportunity for "catch-up" at the Blackwell-Tonkawa site. Some payload issues were resolved on the Twin Otter at the Ponca City Airport throughout the day.

Monday, 3/13/00 -

There was a possibility of clouds moving into the area on Monday; therefore, we were prepared to fly with the final decision made on the basis of conditions this morning. Unfortunately, only scattered cirrus clouds developed and we did not fly today. Conditions appear to favor the development of suitable clouds over the next several days. We will be prepared to fly on Tuesday with the final decision once again made in the morning. The best conditions of the week for ARESE II are expected on Thursday.

Steven Cole, a science writer preparing an article for the New Scientist magazine on the ARESE II deployment, visited the Blackwell-Tonkawa and Ponca City Airports today to discuss ARM-UAV. He also visited the CART site and will be visiting the ARM Science Team meeting in San Antonio, Tx, later in the week.

Tuesday, 3/14/00 -

Once again, we were prepared to fly today and, once again, the cloud conditions were not favorable for ARESE or for the cloud IOP. Low broken clouds that were expected to tend toward scattered clouds as the day progressed dominated the conditions in the CART site area. It still appears that better clouds should move into the area on Wednesday with Thursday expected to bring the best conditions of the week.

Wednesday, 3/15/00 -

Conditions were not expected to be particularly good for an ARESE flight on Wednesday. There was a low and relatively thin overcast in the morning that transitioned to broken clouds before noon; therefore, the flight for today was cancelled. Thursday still looks like a good day, although icing conditions and high winds could be an operational problem. We will be prepared to fly on Thursday and make the decision at the 8:00 am CST weather briefing.

Thursday, 3/16/00 -

Wednesday night brought severe thunderstorm warnings and rain to the Ponca City area. Thursday morning conditions were colder (temperatures in the mid- to upper-30's) with an overcast at about 1000 ft agl and rain expected to change to snow later in the day. The cloud layer extended up to 15 to 18 kft with cirrus clouds in the area extending up to as high as 35 kft. Unfortunately, the freezing level was relatively low and moderate rime icing was predicted from 6 kft to 16 kft. The flight was held until 10:00 am in hope of improving conditions but ultimately postponed until Friday, when continued stratus clouds are expected in the area.

Friday, 3/17/00 -

The luck of the Irish was with us today. Friday brought low ceilings with rain, icing from the freezing level to clouds tops, high altitude buildups south of the CART area (with cloud tops reported from 20,000 ft to 35,000 ft) moving north. During the preflight, it was clear that the conditions below the overcast would prevent accomplishing the albedo runs before climbing to altitude. However, it appeared that conditions might allow getting above the clouds over the CART site. Therefore, we ran through the checklist with the option of holding or canceling if conditions did not improve.

The Twin Otter took off at 10:39 am CST and climbed through the overcast with acceptable icing during climb and broke into the clear at about 15 kft. During climb, the Twin Otter accomplished 3 legs of the "daisy" pattern above the clouds and reached 23 kft about 22 minutes before the Terra overcrossing. The Twin Otter happened to be almost exactly over the CART CF at 11:52 am CST overcrossing.

There were multiple layers with a thin cirrus deck above the Twin Otter altitude (23 kft). The pilots reported that it was thicker to the north than the south and it thinned during the flight. The Citation supporting the IOP took off at about 11:30 am CST and performed vertical profiling over the CART site while the Twin Otter was flying the "daisy" pattern. Around solar noon, the Citation flight crew reported low cloud layers at 5.5 kft, 6 kft, and 9 kft and the Twin Otter reported a thin cirrus layer above their altitude. The Twin Otter conducted 11 level flight legs at 23 kft before descent for the albedo legs at approximately 500 ft agl. Landing was at about 2:00 pm CST. Total flight time was about 3 1/2 hours with about 1 1/2 hour at 23 kft.

Saturday, 3/18/00 -

The ceilings were quite low with limited visibility early on Saturday. Ponca City airport was reporting 200 ft ceiling and 0.75 mile visibility at 6:00 am with gradual improvement predicted later in the morning. These conditions prevented bringing the Twin Otter to Blackwell-Tonkawa Airport for the preflight. However, conditions in the area did allow a direct departure from Ponca City starting about 10:00 am. We performed the preflight checklist at the Ponca City airport with the Mission Controller and Ground Crew in cell phone contact with the PGS at the Blackwell-Tonkawa Airport. In part due to wet conditions, the payload ground station was able to acquire the Twin Otter signal on the ground at the Ponca City airport.

There was concern about another trough moving into the area later in the day that could bring a return of lower ceilings and visibility. Takeoff was at about 10:15 am CST with direct climb to 23 kft at 11:09 am CST. The cloud layer was uniform without substantial layering up to the cloud tops at about 11.4 kft. There was some ice accumulation at the cloud top altitude just prior to entering clear air. The Twin Otter completed 3 legs of the daisy pattern above the clouds during climb (about 30 minutes) and 3 level data legs at 23 kft (about 24 minutes) before a hydraulic problem on the Twin Otter forced an early return to Ponca City Airport for landing at about 12:00 pm. Total flight time was 1 hour 45 minutes.

The Twin Otter will require maintenance before it will be ready for flight. The parts will be delivered Sunday morning; therefore, there isn't a possibility of a flight on Sunday.

Sunday, 3/19/00 -

After much effort to get expedited delivery on Saturday night, the parts for the Twin Otter will arrive on Sunday - precluding a flight today. At 6:00 am, there was a general overcast that began to break at 11:00 am with scattered cumulus clouds in the afternoon. Some payload calibration and maintenance was performed today in addition to aircraft repairs. It appears that Monday will be a clear day; therefore, we are tentatively planning another clear sky flight using the same "daisy" pattern as used on the cloudy days.

Monday, 3/20/00 -

Monday morning was clear and cold with some surface haze; therefore, we brought the Twin Otter to Blackwell-Tonkawa in preparation for a clear sky flight. Takeoff was at 10:25 am CST (1625Z). Some mid-level clouds appeared at a significant distance to the northwest and north of the CART site around 11:00 am (1700Z). The Twin Otter completed two albedo runs over the CART site and then climbed to 23 kft along legs of the "daisy" pattern. Around noon, the clouds to the northwest continued to move to the north, away from the CART area. After reaching 23 kft, the Twin Otter completed 16 data legs on the "daisy" pattern and then descended for another albedo run over the CART site at 500 ft agl. Landing at Ponca City Airport was at about 2:00 pm (2000Z) for a total flight time of 3 hours 30 minutes and 2 hours in level flight at 23 kft. There were no clouds visible in the sky by landing time.

Tuesday, 3/21/00 -

The ARESE II team completed a daisy pattern mission above a slowly varying stratiform cloud layer as the the UND Citation sampled the cloud microphysics. All instrumentation appeared to function normally. The Otter spent about 2 hrs and 6 minutes at 23 kft followed by an albedo run in the vicinity of the CART site. On ascent, the cloud layer was situated between about 3.2 and 10.5 kft. During the flight the layer thinned, with the bases observed at about 7.3 kft when the Otter descended through the clouds at the end of the flight. The thinning is noticeable in the IR satellite pictures (see attached). Nonetheless, the skies remained overcast throughout.

Please note that the Otter flight was skewed relative to local noon in order to avoid an approaching thick cirrus deck. The time on station was from about 16:44 to 18:51 CST. Local noon is about 18:35.

The clouds on this mission appear to have had more structure than on previous flights. Likewise, I suspect that small cirrus patches drifted by at different times. Nonetheless, it appears to be a successful mission.

Wednesday, 3/22/00 -

Thursday, 4/6/00 -

Flight operations for the ARESE II deployment have officially ended. We flew 15 science flights during the period of February 27th through April 5th. Four flights were cloudy sky ARESE missions. Two additional cloudy sky ARESE missions were cut short by cloud or aircraft conditions. Five clear sky ARESE missions were flown, including one night flight. Four cirrus missions, flown in support of the Cloud IOP program, were completed during the first ten days of March. In all, we flew over 26 hours collecting data at altitude, with over 44 hours of total flight time. Data-taking time for ARESE clear sky missions was 8 hours 24 minutes. For cloudy sky missions, we collected data for 7 hours 43 minutes, plus an additional 1 hour 37 minutes for the shortened flights. In support of the cloud IOP, we collected data for 8 hours 27 minutes.